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APPLIED RESEARCH ON SEC AMPLIFICATION CAMERA TUBE

INTERIM ENGINEERING REPORT NO. I

December 1, 1962 to March 1, 1963

Contract AF33(657)-9190

Aeronautical Systems Division
Wright-Patterson Air Force Base, Ohio

G. W. GOETZE
Applied Physics Department

RESEARCH REPORT 63-912-255-R5



WESTINGHOUSE RESEARCH LABORATORIES
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Pittsburgh 35, Pennsylvania

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ABSTRACT

As a result of Contract AF33(657)-8017, a new type of storage target for use in camera tubes has been developed. This target is based on the principle of secondary electron emission and secondary electron conduction of a low density deposit of an insulator or semiconductor under excitation of KeV electrons. This target, hereafter referred to as SEC-target, is described in detail in the final report on Contract AF33(657)-8017. This first interim report describes the design, fabrication and preliminary evaluation of the first three, out of eight, SEC-Vidicons to be constructed under Contract AF33(657)-9190.

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Objective

The objective of the present research contract is to determine the feasibility of a camera tube having an SEC-target. In particular, the contract calls for the following areas of consideration:

1. Techniques for producing larger format SEC-targets.
2. Electron optics of image sections operating at the voltages determined to be optimum for the SEC-target.
3. Interaction between SEC targets and photocathodes of the S-11 and S-20 type.

The contract is to culminate by the construction and evaluation of at least one SEC-camera tube with vidicon-type readout. This tube is to employ electromagnetic focusing in both the image section and scanning section, a S-20 photocathode of normal (greater than 100 $\mu\text{A}/\text{lumen}$) sensitivity and an edge-supported, large format target. The evaluation of this tube should afford a direct comparison of its performance with other camera tubes.

Experimental SEC-Vidicons

During the reporting period, preliminary experiments were carried out to determine design parameters and adequate processing techniques. A sealed-off image section and a Vidicon with an experimental electron gun were built to evaluate the performance of these tube components individually. With satisfactory results obtained from these tests, it was decided that eight tube starts should be sufficient for the successful completion of the program. Three complete tubes have been built to date and have been partially evaluated.

In the following, a description of the more important tube parameters is given. A brief summary of the general test results obtained with the first three tubes is offered rather than a detailed description of the experimental difficulties encountered during tube manufacturing and evaluation. A more complete analysis of the program as well as the final test results has to be reserved for the final report on this contract.

The tubes built consist of an S-20 photocathode, a one-inch diameter edge-supported SEC-target and a modified vidicon gun capable of scanning a 1" x 1.34" raster. Image section and gun section are focused magnetically by a single focus coil operating at 75 to 80 gauss. The photocathode is operated at approximately -10 KV with respect to the target. A standard image orthicon yoke is used for beam deflection. The video signal is derived from the target backplate, which is operated several volts positive with respect to gun cathode potential in the normal fashion.

The photocathode response of the first three tubes is 80, 120, and 180 μ Amps/lumen. All three tubes have been operated and showed no apparent adverse effects of S-20 processing on target performance. The overall performance of tube No. 1 and 2 was unsatisfactory, mainly due to electrical leakage between gun electrodes and/or excessive amount of gas released during initial filament activation. These problems have been pin-pointed and corrective measures will be taken in future tubes.

Tube No. 3 has shown promising overall performance and might qualify for delivery pending completion of a more careful evaluation.

In detail, the photocathode response of this tube was $180 \mu\text{A}/\text{lumen}$ at tip-off and has shown no decrease in sensitivity during operation and storage. The readout speed is fast, i.e., the signal is erased to less than 10% of its initial value after one field. Target gain has not yet been measured separately, but appears to be low judged by the overall tube sensitivity. This is mainly so, because target voltage was intentionally kept below 2 volts, at which point the target shows about five small blemishes. At normal gun voltages, the tube is capable of resolving 15 lp/mm as observed visually from the monitor. The overall tube performance is illustrated in Fig. 1, which shows a plot of limiting resolution vs. photocathode illumination for 100% contrast and for 10% contrast.

Conclusion

Judged by the preliminary data obtained from the first three experimental SEC-Vidicons, it is concluded that feasibility of a camera tube with an SEC-target can definitely be demonstrated by the end of this contract. In particular, the demonstrated compatibility of an S-20 photocathode with the SEC-target is considered important progress towards a positive fulfillment of the objective of this contract.

Recommendations

It is recommended that the program be continued with the construction and evaluation of five more experimental SEC-vidicon tubes.

Acknowledgements

The valuable assistance by Westinghouse Electron Tube Division personnel during this contract is greatly acknowledged. Messrs. H. Shabanowitz and A. H. Boerio have made significant contributions to this program.

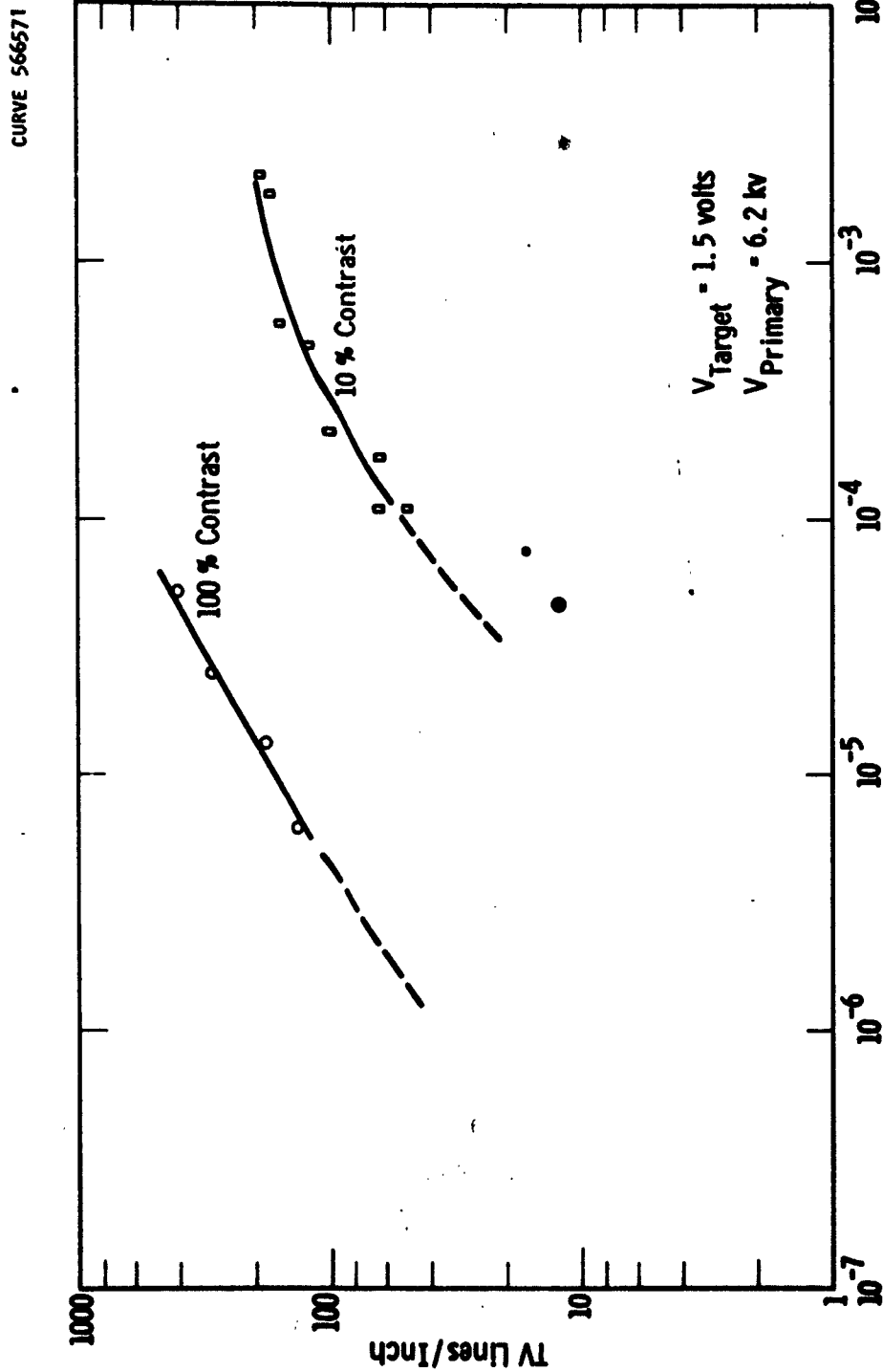


Fig. 1-Limiting resolution vs. photocathode illumination (Tentative), SEC - Vidicon #3